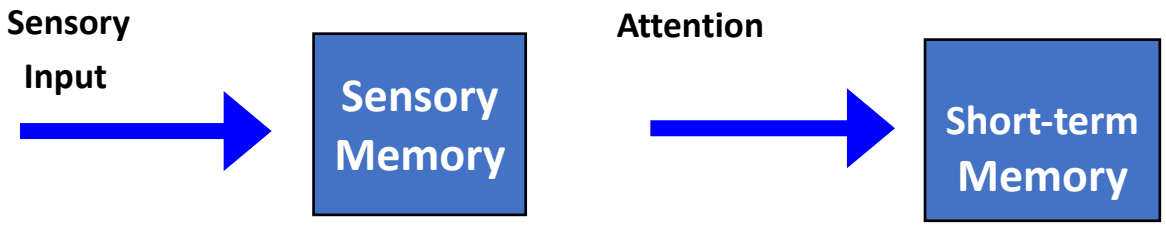
SHORT TERM OR WORKING MEMORY



Short-term memory (STM) is a limited-capacity store that can maintain unrehearsed information for up to about 20 seconds. In contrast, information stored in long-term memory may last weeks, months, or years. You can maintain information in your short-term store for longer than 20 seconds. By engaging in rehearsal—the process of repetitively verbalizing or thinking about information.

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Durability of Storage

Without rehearsal, information in short-term memory is lost in **15 to 30 seconds** (Nairne, 2003). This rapid loss was demonstrated in a study by Peterson and Peterson (1959). They measured how long undergraduates could remember three consonants if they couldn't rehearse them. To prevent rehearsal, the Petersons required the students to count backward by threes from the time the consonants were presented until they saw a light that signalled the recall test. Participants' recall accuracy was pretty dismal after only 15 seconds. Other approaches to the issue have suggested that the typical duration of short-term memory storage may even be shorter (Baddeley, 1986). Theorists originally believed that the loss of information from short-term memory was attributable purely to time-related *decay* of memory traces, but follow-up research showed that *interference* from competing material also contributes (Oberauer & Lewandowsky, 2014; Nairne & Neath, 2013).

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Capacity of Storage

Short-term memory is also limited in the number of items it can hold. The small **capacity of short-term memory was pointed out by George Miller (1956) in a famous paper called "The Magical Number Seven, Plus or Minus Two**: Some Limits on Our Capacity for Processing Information." Miller noticed that people could recall only about seven items in tasks that required the use of short-term memory. When short-term memory is filled to capacity, the insertion of new information "bumps out" some of the information currently in short-term memory. The limited capacity of short-term memory constrains people's ability to perform tasks in which they need to mentally juggle various pieces of information (Baddeley & Hitch, 1974).

The capacity of short-term memory may even be less than widely assumed. Nelson Cowan (2005, 2010) cites evidence indicating that the capacity of short-term memory is 4 plus or minus 1. The consensus on the capacity of short-term memory seems to be moving toward this smaller estimate (Lustig et al., 2009).

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According to Cowan, the capacity of short-term memory has historically been overestimated because researchers have often failed to take steps to prevent covert rehearsal, **or chunking**, by participants. It has long been known that people can increase the capacity of their short-term memory by combining

stimuli into larger, possibly higher-order units, called *chunks* (Simon, 1974). **A *chunk* is a group of familiar stimuli stored as a single unit.** You can demonstrate the effect of chunkinby asking someone to recall a sequence of twelve letters grouped in the following way:

FB - INB - CC - IAIB - M

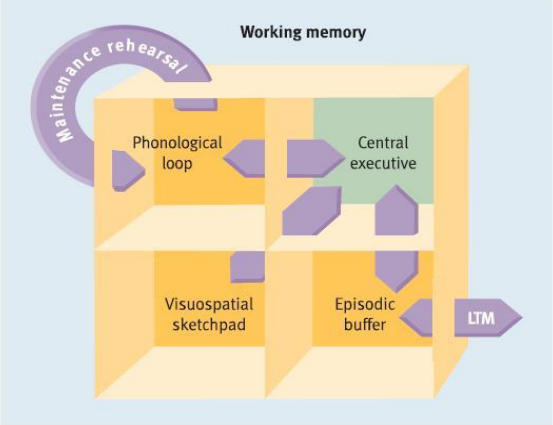
As you read the letters aloud, pause at the hyphens. Your subject will probably attempt to remember each letter separately because there are no obvious groups or chunks. But a string of twelve letters is too long for STM, so errors are likely. Now present the same string of letters to another person, but place the pauses in the following locations:

FBI - NBC - CIA - IBM

The letters now form four familiar chunks that should occupy only four slots in short-term memory, resulting in successful recall (Bower & Springston, 1970).

To successfully chunk the letters I B M, a subject must first recognize these letters as a familiar unit. This familiarity has to be stored somewhere in long-term memory. Thus, in this case, information was transferred from long-term into short-term memory. This type of transfer is not unusual. People routinely draw information out of their long-term memory banks to evaluate and understand information that they are working with in short-term memory.

Short-Term Memory as "Working Memory"



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Research eventually suggested that short-term memory involves more than a simple rehearsal buffer, as originally believed. The findings prompted Alan Baddeley (1992, 2001,2012) to propose a more complex model of short-term memory that characterizes it as **working memory—a modular system for temporary storage and manipulation of information.** Baddeley's model of working memory consists of four components. The first component is the phonological loop, which represented all of short-term memory in earlier models. This component is at work when you use recitation to temporarily hold onto a phone number.

Baddeley (2003) believes that the phonological loop evolved to foster the acquisition of language. The second component in working memory is a visuospatial sketchpad that permits people to temporarily hold and manipulate visual images.

This component is at work when you try to mentally rearrange the furniture in your bedroom. The third component is the central executive system. It controls the deployment of attention, switching the focus of attention and dividing attention, as needed. The fourth component is the episodic buffer, a temporary, limited capacity store that allows the various components of working memory to integrate information and that serves as an interface between working memory and long-term memory.

Baddeley's model of working memory has generated an enormous volume of research. For example, research has shown that people vary in how well they can juggle information in their working memory while fending off distractions (Wiley & Jarosz, 2012). **Working memory capacity (WMC) refers to one's ability to hold and manipulate information in conscious attention.** Working memory capacity is a stable personal trait (Unsworth et al., 2005) that appears to be influenced to a considerable degree by heredity (Kremen et al., 2007).

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